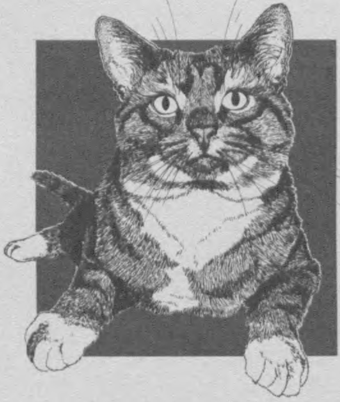


Cornell Feline Health Center

Veterinary News

Winter 1984

Veterinary Diagnostic Ultrasonography

N. Sydney Moise, D.V.M., D.A.C.V.I.M.

Primum non nocere.
Latin. First do no harm.

As veterinary clinicians we usually relate this ancient rule of medicine to the therapeutic intervention of disease; however, we are often aware of this statement's truth concerning diagnostic procedures. During our daily veterinary practice we are reminded that many of the necessary diagnostic tests we perform subject animals to a certain amount of stress, and sometimes danger. As feline practitioners we are even more cognizant of this factor. Since a cat is small, many invasive procedures are more difficult than in the dog. Also, a cat's apprehensive temperament often necessitates chemical restraint. Therefore, a noninvasive, painless way for reaching a diagnosis is desired.

Ultrasonography can provide this means in many situations. For example, to characterize the type of cardiomyopathy that a cat possesses as either dilated, hypertrophic, or restrictive, an angiogram is usually required, since electrocardiograms and radiographs do not render a specific classification. Therapy and prognosis are dependent on the correct diagnosis. Ultrasonography can give the definitive diagnosis because the heart walls and chambers may actually be seen and their size measured. Also, the contractility of the heart can be accurately assessed. This vital information can be obtained with ultrasonography without the pain, anesthesia, catheterization, dye injection, or radiation involved with angiography.

The use of diagnostic ultrasound in veterinary medicine promises to be a rewarding and exciting endeavor. However, as with any diagnostic aid, ultrasonography is just that - an aid to the proper diagnosis. The foremost restriction is availability due to high cost. Despite any drawback that this new venture in veterinary medicine may have, an awareness of ultrasonography on the part of veterinarians is important.

The basic principle behind ultrasonography involves the use of high frequency sound waves directed toward soft tissue structures, the reflection of these waves as they hit interfaces of soft tissues, and the processing of the returned sound waves to form a meaningful picture. An ultrasound unit or echograph sends and receives millions of ultrasound waves through a hand-held transducer. The transducer contains a synthetic crystal that possesses the property of piezoelectricity. The piezoelectric property means that a material has the ability to convert electrical signals into mechanical vibrations and vice versa. Thus, nonaudible sound waves (ultrasound) are produced. The transducer can send and receive these ultrasound waves. Some of the ultrasound waves sent from the transducer bounce back once they hit a boundary between tissues that transmit sound differently. An example of such a boundary is the interface between the blood and wall of a heart chamber. The sound waves that are bounced back are converted back to electrical energy and then to a picture which is displayed on the video screen. Since sound waves do not easily penetrate bone or easily travel through gas-filled structures (e.g., lung, gaseous loops of bowel), examinations are limited to fluid density soft tissue organs and structures (heart, liver, kidney, etc.). When performing an ultrasound examination, the transducer is placed against the skin of the animal and directed toward the organ to be scanned. As the transducer is moved, different structures appear on the echograph's screen.

Echographs have been used for over three decades in human medicine. However, the technology has evolved to a highly sophisticated form in the past decade, and the advances being made today are tremendous.

The two modes of ultrasound most commonly employed today are M-mode (motion mode) echocardiography and two-dimensional (2-D) ultrasonography. M-mode echocardiography is used to evaluate the heart. This form of ultrasonography allows a study of the heart walls, valves, and chambers. The size of these structures can be measured and their motion evaluated. With M-mode echocardiograms a single beam of ultrasound is directed toward the heart. To the untrained eye, the resulting images appear merely as numerous moving lines; however, once interpretation of the echogram is mastered, a wealth of information can be retrieved. This form of ultrasound has been and continues to be used principally by cardiologists. With the development of 2-D ultrasonography, a more complete picture of the heart and other soft tissues can be obtained. A more complete image is possible because instead of using a single sound beam, multiple ultrasound waves are directed over a greater area of the studied organ. This is accomplished by rapidly moving the single beam (mechanical transducer) or by numerous lined single beams (linear transducer) or by lined electronically fired sound beams (phased array transducer). Two-dimensional ultrasonography produces a picture that is much more understandable to the untrained eye and an increased amount of information may be obtained. Many of the commercial ultrasound units marketed today for cardiac studies incorporate both M-mode and 2-D ultrasound.

What diagnoses are possible with ultrasonography? The following are some examples of what can be seen with 2-D ultrasonography: congenital heart defects (ventricular septal defect, tetralogy of Fallot, pulmonic and aortic stenosis, etc.); cardiac valvular lesions; cardiomyopathies; intracardiac masses; heartworms; polycystic kidneys; hydronephrosis; renal calculi; renal masses (parenchymal and pelvic); cystic calculi (urinary bladder and gall bladder); enlarged, obstructed gall bladder; hepatic masses; portocaval shunts; prostatic disease; pregnancy determination; and abdominal mass identification (i.e., mesenteric mass vs. splenic mass). In addition, biopsy of tissues can be guided by ultrasound; therefore, nonsurgical biopsies no longer have to be done "blindly."

The exciting aspect of ultrasonography is that the diagnoses listed above can be made noninvasively, without subjecting the animal to pain, stress, or danger. Also, studies may be repeated over and over again without risk. Repetition is possible because the procedure does not harm the patient, and we as the instrument operators are not exposed to any hazards, such as radiation.

What are the disadvantages of ultrasound? At this point excessive cost is the most inhibiting factor to the advancement of veterinary ultrasonography. Used M-mode echographs are becoming available at more affordable prices ($500-$5,000) as human hospitals discard their older units and replace them with combination M-mode/2-D units. The disadvantage of the "M-mode only" echograph, as stated, is that the scanning is limited to the heart.

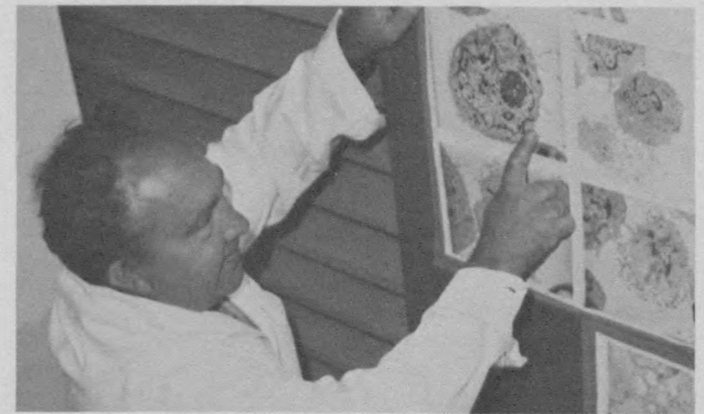
Some companies are now producing lower cost 2-D ultrasound units for the veterinary market. However, although a couple

(Continued on page 7.)

Dr. Fernando de Noronha Leads FeLV Research Team

Fernando de Noronha, D.V.M., Professor of Virology and viral oncology laboratory chief, recently received an annual allocation of $105,454 from the National Institutes of Health for his research entitled "Serotherapy of Virus-Induced Sarcoma or Leukemia." This most recent award is a continuation of a three-year grant, and the latest milestone in Dr. de Noronha's 20-year history of investigating feline leukemia virus (FeLV) and feline sarcoma virus (FeSV).

Serotherapeutic techniques developed during his current project have produced FeLV/FeSV tumor regression in approximately 70% of the experimental cases. These techniques have involved the use of heterologous and homologous sera from hyperimmunized animals directed against the FeLV glycoprotein gp70, the target antigen for FeLV-neutralizing antibody. Recently Dr. de Noronha's laboratory developed a panel of monoclonal antibodies directed against gp70. Because this glycoprotein is expressed on the surface of FeLV particles and also on the surface of FeLV-infected cells, they plan a new approach



Dr. Fernando de Noronha explains the mechanism of serotherapy against feline leukemia virus.

which will involve tagging of anti-gp70 monoclonal antibodies with toxins such as ricin. These tagged antibodies will then be used as "bullets" against the FeLV-infected cells. This procedure, unlike chemotherapy, which employs large amounts of drugs deleterious to both cancer cells and normal cells, will use minimal amounts of toxins directed only against the infected cells and virus.

Dr. de Noronha received his D.V.M. at the Escola Superior de Medicina Veterinaria, Universidade Technica de Lisboa, in Lisbon, Portugal, in 1950. He built a solid reputation as a veterinary researcher and virologist while holding various positions in Spain, France, England, Germany, and his native Portugal. In 1964 he joined the New York State College of Veterinary Medicine at Cornell as an Associate Professor of Virology, beginning the FeLV/FeSV studies that have occupied him nearly full time ever since. He and a Cornell research group were instrumental in isolating and identifying these feline retroviruses in the United States and establishing Cornell's Specific Pathogen-Free (SPF) Cat Colony of research animals to study feline diseases in vivo. Sustained efforts to develop a vaccine for FeLV continue in his laboratory. Thirty-six scientific publications have resulted from Dr. de Noronha's important work here.

Cornell Feline Health Center
Veterinary News
A publication for veterinary professionals

The ultimate purpose of the Cornell Feline Health Center is to improve the health of cats everywhere, by developing methods to prevent or cure feline diseases, and by providing continuing education to veterinarians and cat owners. All contributions are tax-deductible.

Director: **Fredric W. Scott, D.V.M., Ph.D.**
Editor: **Joyce Tumbelston**
Secretary: **Sheryl A. Bronger**
Special Consultant: **Leo A. Wuori, D.V.M.**

©1984 by Cornell University on behalf of the Cornell Feline Health Center, College of Veterinary Medicine, Ithaca, NY 14853. All rights reserved. Permission to reprint selected portions must be obtained in writing. Cornell University is an equal opportunity, affirmative action educator and employer.

Intraocular Inflammation in Cats as a Manifestation of Systemic Diseases

Thomas J. Kern, D.V.M., D.A.C.V.O.

The normal gleam in a healthy cat's eyes may betray its devious personality, its predatory cunning, or its mischievous intent. Alterations in this appearance may foretell affliction with one of several feline systemic diseases long before changes in the cat's apparent health are obvious. To the observant cat owner and veterinary practitioner even subtle changes in appearance of a cat's eyes should prompt diagnostic pursuit.

The types of altered ocular appearance commonly noted by cat owners include:

1. Acquired, progressive change in iris color - especially if only one eye.
2. Progressive clouding in or on the eye (Figure 1).
3. Gradual loss of vision associated with either (1) or (2).
4. Gradual increase in eye size.

The ocular examination findings which parallel these owners' complaints include:

1. Acquired heterochromia: due to either iris pigment increase or loss.
2. Rubeosis iridis: new blood vessel growth on the anterior iris surface.
3. Dyscoria, with or without posterior synechiae.
4. Hypopyon.
5. Keratic precipitates: corneal endothelial plaques of mononuclear inflammatory cells.
6. Cataract.

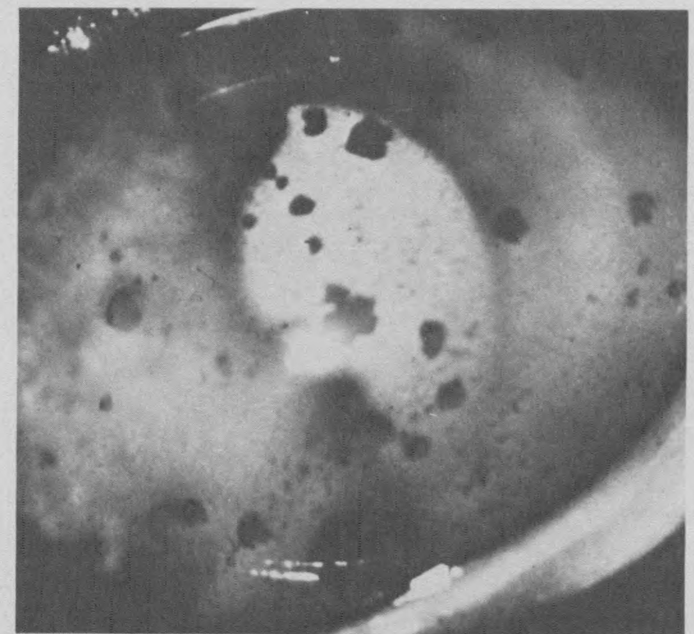


Fig. 1. Chronic active anterior uveitis in a cat, characterized by keratic precipitates, dyscoria, rubeosis iridis, and iris infiltration.

7. Flocculent anterior vitreal opacities.
8. Chorioretinitis.
9. Optic neuritis.
10. Chronic glaucoma.

Assessment of these findings should suggest chronic active anterior and/or posterior uveitis. In most animal species of veterinary interest, uveitis is an infrequently manifested clinical sign of a myriad of systemic diseases, many of which defy clinical and laboratory diagnosis. However, two disease categories, infectious and neoplastic, are responsible for a high percentage of documentable causes of feline uveitis.

All of the aforementioned changes are potentially visible to the naked eye of the pet owner or veterinarian. Surprisingly, cats usually show minimal behavioral evidence of ocular discomfort, save for occasional subtle behavioral alterations associated with diminishing vision. Usually, even a minor serous discharge from the eye is absent.

Infectious Diseases

Viral, parasitic, and fungal agents are potentially responsible for chronic feline uveitis.

Feline infectious peritonitis (FIP), due to infection with a coronavirus, frequently boasts ocular complications. Even in the absence of clinical systemic signs of disease, unilateral or bilateral ocular signs are often prominent enough to impair vision or capture an owner's attention. Perivascular pyogranulomatous inflammation causes a breakdown in the blood-aqueous barrier and leakage of fibrin and inflammatory cells into aqueous humor or vitreous. Retinal perivasculitis is infrequently noted as fluffy infiltration within the retina near blood vessels. Choroidal inflammation frequently causes subretinal fluid exudation and secondary bullous or linear retinal detachments; solitary chorioretinal granulomas are infrequently recognized.

Toxoplasmosis is a significant cause of feline uveitis in endemic areas. Most often systemic signs of visceral toxoplasmosis are absent or vague at best. Discrete iris or chorioretinal granulomas are infrequently noted. Active retinitis or chorioretinitis occasionally accompanies chronic anterior uveal inflammation.

Fungal agents responsible for the deep mycoses (histoplasmosis, blastomycosis, coccidioidomycosis, cryptococcosis) are also likely etiologic candidates in endemic areas. Even in the apparent absence of visceral involvement, granulomatous anterior and posterior uveal inflammation may be fulminating or insidious. Discrete iris and chorioretinal granulomas are occasionally notable.

Neoplasia

Both primary and metastatic neoplasia may mimic chronic intraocular inflammation in clinical ocular presentation and course.

Primary uveal tumors in cats - melanomas, cilicary adenomas and adenocarcinomas - usually present as readily recognizable discrete uveal masses. Minor chronic inflammation associated with such neoplasms may ensue.

Metastatic neoplasms from primary tumors may exist as solitary uveal masses or diffuse infiltrative uveal lesions. Possibly the most frequently documented secondary intraocular tumor is multicentric lymphosarcoma. Metastatic feline sarcomas, mammary tumors, and adenocarcinomas have also been noted in the veterinary literature.

Diagnosis

Diagnostic discrimination of these infectious agents from one another or from applicable neoplastic disorders cannot be reliably made on clinical signs alone. While the spectrum of ocular clinical signs in an individual cat may typify one disease compared to another, these differentiating characteristics are more conceptually than clinically accurate. All three infectious diseases as well as neoplasia must be considered and ruled out in every instance of chronic feline uveitis.

The diagnostic plan for such feline cases should include:

1. Complete physical examination.

2. Hemogram.

3. Feline leukemia (FeLV) test.

4. Coronavirus (FIP) and toxoplasma serum titers.

Documentation of high initial coronavirus or toxoplasma titers or serial rise in titer over the course of ocular disease progression or management may implicate the respective agent. A positive FeLV test correlated with appropriate physical and hematologic findings may suggest lymphosarcoma as the most likely ocular diagnosis. If physical examination, hematologic, and serologic parameters are noncontributory to the diagnosis, further diagnostic evaluation is indicated.

The deep mycoses are difficult to document as etiologic agents. Chest radiography may demonstrate interstitial pneumonia. Anterior chamber paracentesis for cytologic examination and culture, while ordinarily not indicated, in such instances may be the only method to document ocular fungal infection. As a last resort, serum titers for the fungal agents may cast suspicion toward one of them.

Other unusual infectious agents and immune-mediated disorders may rarely be associated with chronic uveitis in cats. Laboratory confirmation of these infrequent etiologies is considerably more difficult and less reliable than for the aforementioned disorders. For these reasons, the more readily documentable etiologies are ruled out before the other disorders are investigated.

Treatment

Ideally, the two primary objectives of therapy for uveitis are: (1) to eliminate the associated systemic disease and (2) to prevent blinding ocular sequelae. Realistically, therapy for FIP, toxoplasmosis, FeLV-associated diseases, and the deep mycoses is difficult and often unrewarding. For FIP, supportive therapy, perhaps in conjunction with judicious corticosteroid therapy, is indicated. Recommendations for toxoplasmosis treatment are available in current veterinary literature, but the available drugs appear to have limited success in eliminating the protozoan and may cause unacceptable side effects. Experimental usage of newer drugs, e.g., clindamycin and minocycline, in laboratory animals may offer more promising clinical results in the future. Cancer chemotherapy for FeLV-related syndromes may be a viable palliative measure for selected feline patients. For deep mycoses, parenteral therapy with newer, relatively safe fungistats like ketoconazole offers some hope for control and even cure.

Specific treatment for the systemic disease notwithstanding, specific ocular therapy is necessary to delay or prevent the blinding sequelae of chronic uveitis, e.g., secondary glaucoma, cataract, pupil seclusion, and retinal degeneration.

To reduce the chronic inflammation, topical corticosteroid-antibiotic medications should be used long-term and to effect. To preserve pupil integrity, topical 1% atropine therapy, also to effect, is indicated. This drug's cycloplegic effect ameliorates much of the ocular discomfort associated with uveitis. Chronic secondary glaucoma, a frequent insidious result of uveal inflammaton, must be recognized early in its course to preserve vision as long as possible. In conjunction with topical corticosteroid appliaton, use of 0.5% timolol maleate (Timoptic® - Merck, Sharp, and Dome) SID to BID to reduce aqueous humor production is quite effective for intraocular pressure reduction.

With carefully monitored treatment, useful vision can very often be preserved on a long-term basis even when the underlying systemic disease cannot be eliminated.

Conclusions

Feline uveitis is a common clinical complaint, often unrecognized for its true significance as a harbinger of serious systemic diseases. The similarity of the ocular findings due to a myriad of causative agents and disorders precludes definitive diagnosis of etiology. Clinical diagnosis must be corroborated by further

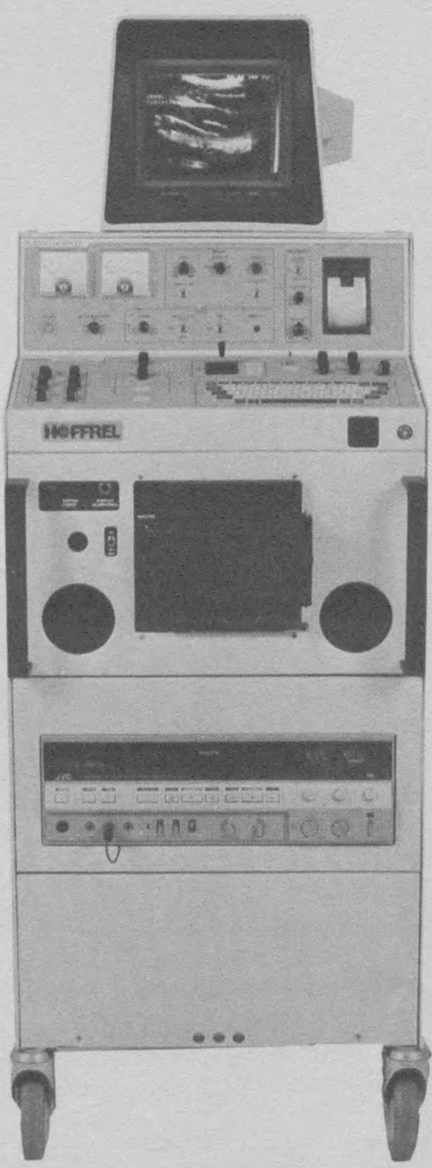
(Continued on page 8.)

Ultrasonography *(Continued from page 2.)*
of companies have made lower priced echographs that are suitable for scanning cats, most of the less expensive 2-D units ($10,000-$15,000) are designed for large animal reproductive scanning. These latter echographs usually do not allow adequate resolution for studying structures as small as the inside of a cat's heart. At the present time it is cost-prohibitive for most practitioners to acquire an echograph capable of quality scanning the cat ($20,000-up). In the near future high quality instrumentation will probably be limited to teaching institutions and large, affluent referral practices. Other reasons for the limited use of ultrasound in the veterinary market are the technical expertise needed to obtain quality images and the training needed for accurate interpretation of the echograms.

With these substantial disadvantages to the expanded use of ultrasonography in veterinary medicine, why is it of any importance to the veterinary profession? Because knowledge of new technology is always essential for the advancement of medicine even when immediate acquisition of the technology seems impractical. The ultrasound units are now available at most referral veterinary institutions. Also, a liaison between veterinarians and human medical doctors in a community may provide a way that animals may be studied by ultrasound. In addition, with the rapid advancement of technology and the increase in competition between companies, perhaps in the next 10 years the cost of an echograph will decrease. In time the price of an echograph may plummet just as the prices of calculators and computers have done over the past decade. Perhaps in the next 20 years an ultrasound unit will be as common in the private veterinary hospital as an electrocardiograph or X-ray unit.

The special training necessary for the operation of an echograph and interpretation of an ultrasonogram will not always be an obstacle, for once the enormous advantages of ultrasonography are grasped and the price becomes affordable, an explosion of interest will spur the commitment for learning this valuable technology.

N. Sydney Moise (Tex '77), a Diplomate of the American College of Veterinary Internal Medicine, is a post-doctoral research fellow specializing in cardiology at the College of Veterinary Medicine, Cornell University.



A new ultrasound unit (pictured above) will be delivered to the Veterinary College in January, 1984, the gift of veterinary alumni. (See story on page 8.)

New Ultrasound Unit Funded by Alumni Gifts

Thanks to our generous veterinary alumni, Cornell will soon have a multipurpose two-dimensional ultrasound unit. This unit will be used in both the small and large animal clinics, as well as for research. A gift of unrestricted funds from the alumni in Spring, 1983, made it possible to order this invaluable piece of equipment.

The unit (pictured on page 7) is a combination 2-D sector and M-mode echograph with many features, including a videotape recorder for "instant replay," multiformat camera, integrated Polaroid®, ECG trigger, and biopsy guide. It will be equipped with four transducers of different frequencies, each allowing a different depth of sound wave penetration and a varying degree of detail in the visual image produced. This feature makes the unit highly adaptable to both large animal use (which requires deep penetration through thick masses of soft tissue and relatively less acuity due to the large size of internal structures) and small animal use (which calls for shallower penetration and more intricate images, due to the minute size of internal structures).

One of the characteristics that led to the choice of this particular unit is its capability of fine resolution of small structures, an important consideration at the Cornell Feline Health Center with respect to our feline cardiomyopathy studies. The new unit will allow detailed visual examination of the feline heart and cardiovascular system.

Delivery of the new ultrasound unit is scheduled for January, 1984. Because of its tremendous diagnostic potential, clinicians and researchers at the College are eagerly awaiting its arrival.

Intraocular Inflammation

(Continued from page 6.)

physical and laboratory examination. Finally, even when definitive therapy is unavailable or ineffective, symptomatic topical therapy is very often successful as a palliative measure.

Thomas J. Kern (Missouri '75), a Diplomate of the American College of Veterinary Ophthalmologists, is an Assistant Professor of Medicine at the College of Veterinary Medicine, Cornell University.

Cornell Feline Health Center
Cornell University
College of Veterinary Medicine
Ithaca, New York 14853